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10/544,085	02/09/2007	Chee On Too	13484/1	8593

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EXAMINER	
MARTIN, MATTHEW T	
ART UNIT	PAPER NUMBER
1795	
MAIL DATE	DELIVERY MODE
10/16/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/544,085	ON TOO ET AL.	
	Examiner	Art Unit	
	MATTHEW T. MARTIN	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-47* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-47* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *9/5/2008*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Status of Claims

1. Claims 1-47 are pending and are examined below.

Claim Objections

2. Claim 21 is objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim cannot depend on another multiple dependant claim. See MPEP § 608.01(n). Therefore, Claim 21 has been examined as if dependant on Claim 17.

3. Claims 28 and 36 are objected to because of the following informalities: In Claim 28, "fwan" should be "furan". In Claim 36, ""electrofimctional" should be "electrofunctional." Appropriate correction is required.

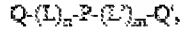
Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

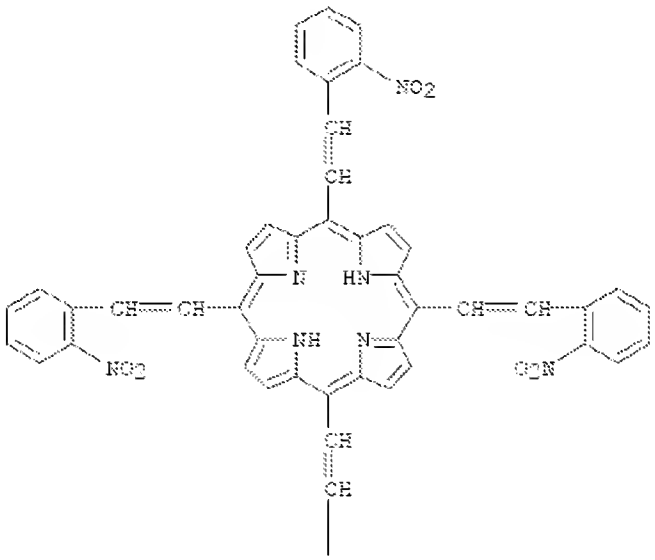
5. Claims 1-6 and 17-21 are rejected under 35 U.S.C. 102(b) as being anticipated by Hevesi et al., Synthesis of meso-Tetravinyl Porphyrins through 1-Selenoallyl Cationic Species", Chemical Communications, 1986 (hereafter Hevesi).

Regarding Claim 1, Hevesi teaches a molecule that meets the structure (See analysis below):



The present specification and claims require that P is a porphyrin or a substituted porphyrin (see claim 5 and pages 8-10), that the linker can be a double bond group (see claim 3 and pages 8-10), and that the polymerizable unit is a substituted aromatic group (see claim 2).

One of the molecular structures taught by Hevesi is:



The above molecule shows P as a porphyin unit, a double bond group where n = 1 as a linker, and a substituted aromatic group as a polymerizible unit (see table 1 and scheme 2), which meets the generic formula of claim 1.

Regarding Claim 2, Hevesi teaches a substituted aromatic group (see table 1, molecule 5g. o-$NO_2C_6H_4$ has a substituted aromatic structure).

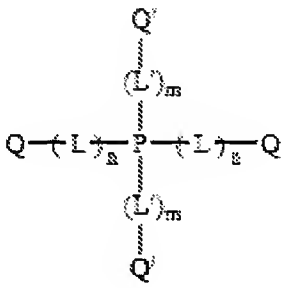
Regarding Claim 3, Hevesi teaches a double bond linking group, where n = 1 (see scheme 2).

Regarding Claim 4, Hevesi teaches that P is a porphyrin (see scheme 2).

Regarding Claim 5, Hevesi teaches that the Q and Q` used have sufficient molecular dimensions to prevent polymerization (see scheme 2). In the present specification, applicant identifies one moiety as sufficient to permit polymerization.

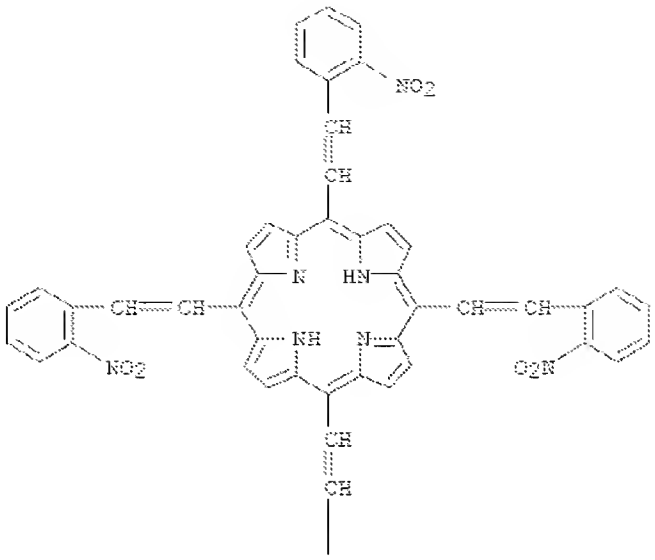
Regarding Claim 6, Hevesi teaches that the Q and Q` used have sufficient molecular dimensions to prevent polymerization (see scheme 2). In the present specification, applicant identifies one moiety as sufficient to permit polymerization.

Regarding Claim 17, Hevesi et al. teaches a molecule according to the formula:



The present specification and claims teach that P is a porphyrin or a substituted porphyrin (see claim 5 and pages 8-10), that the linker can be a double bond group (see claim 3 and pages 8-10), and that the polymerizable unit is a substituted aromatic group (see claim 2).

One of the molecular structures taught by Hevesi is:



The above molecule shows P as a porphyrin unit, a double bond group where n = 1 as a linker, and a substituted aromatic group as a polymerizible unit (see table 1 and scheme 2).

Regarding Claim 18, Hevesi teaches a substituted aromatic group (see table 1, molecule 5g. o-$NO_2C_6H_4$ has a substituted aromatic structure).

Regarding Claim 19, Hevesi teaches a double bond linking group, where n = 1 (see scheme 2).

Regarding Claim 20, Hevesi teaches that P is a porphyrin (see scheme 2).

Regarding Claim 21, Hevesi teaches that the Q and Q` used have sufficient molecular dimensions to prevent polymerization (see scheme 2). In the present specification, applicant identifies one moiety as sufficient to permit polymerization.

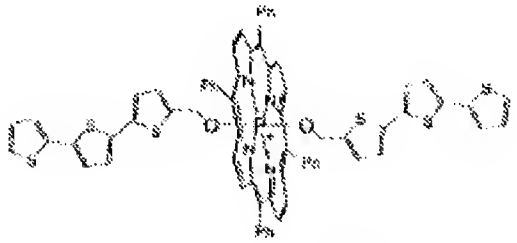
6. Claims 1, 2, 4-12, 14-16, 22-28, 29-33 and 36-46 are rejected under 35 U.S.C. 102(b) as being anticipated by Segawa et al., "Approaches to conducting polymer devices with nano-structure: Electrochemical construction of one-dimensional and two-dimensional oligothiophene copolymers", Synthetic Materials, 1995 (hereafter Segawa).

Regarding Claim 1, Segawa teaches a polymerizable moiety meeting:

$$Q\text{-}(L)_n\text{-}P\text{-}(L')_m\text{-}Q',$$

The present specification and claims require that P is a porphyrin or a substituted porphyrin (see claim 5 and pages 8-10), that the linker provides electrical communication (see paragraph 38), and that the polymerizable unit is a thiophene group (see claim 2).

One of the molecular structures taught by Segawa is:



TT1

Segawa et al. thus shows a monomer unit with a pair of oligothiophenes connected by an oxygen linker to a porphyrin (see fig. 1). The oxygen unit is interpreted by the examiner as a linker group because it provides electrical communication between the oligothiophene and the substituted porphyrin (see introduction, as the electronic transfer system that Segawa teaches is part of the units studied is electrical communication).

Regarding Claim 2, Segawa teaches Q and Q' as oligothiophenes and thiophenes (see fig. 1).

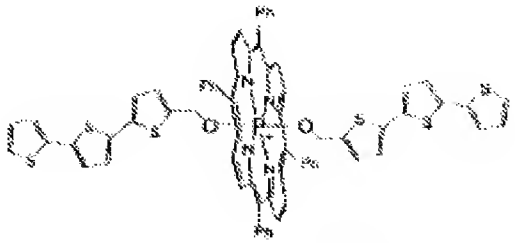
Regarding Claim 4, Segawa teaches a porphyrin electrofunctional unit (see fig. 1).

Regarding Claim 5, Segawa teaches molecular dimensions of Q and Q' sufficient to allow polymerization, because Segawa polymerizes the unit (see section 3.22, first full paragraph).

Regarding Claim 6, Segawa et al. teaches multiple electrofunctional polymers with the structure:

The present specification and claims teach that P is a porphyrin or a substituted porphyrin (see claim 5 and pages 8-10), that the linker provides electrical communication (see paragraph 38), and that the polymerizable unit is a substituted thiophene (see claim 2).

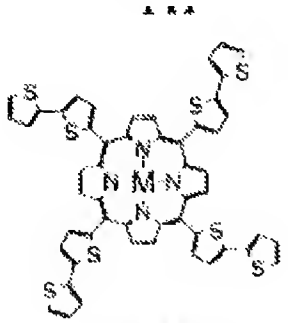
One of the molecular structures taught by Segawa is:



TT1

Segawa et al. thus shows a monomer unit with a pair of oligothiophenes connected by an oxygen linker to a porphyrin (see fig. 1). The oxygen unit, corresponding to n = 1, is interpreted by the examiner as a linker group because it provides electrical communication between the oligothiophene and the substituted porphyrin (see introduction, as the electronic transfer system that Segawa teaches is part of the units studied is electrical communication). Furthermore, Segawa et al. teaches that the above unit has been polymerized.

Segawa additionally teaches other monomer units such as:



TBTP

Where n = 0. Furthermore, these can be considered a copolymer, as Segawa et al. teaches them as a copolymer between the porphyrin and the oligothiophene (see introduction), thus further satisfying the limitations of Claim 6.

Regarding Claim 7, Segawa teaches Q and Q' as oligothiophenes (see fig. 1).

Regarding Claim 8, Segawa teaches a copolymer where n, in the linker, is equal to 0 (see section 3.1).

Regarding Claim 9, Segawa et al teaches that p is a porphyrin (see fig. 1).

Regarding Claim 10, Segawa et al. teaches that the polymer can be a copolymer, as the poryphrin can be considered the second monomer unit (see introduction).

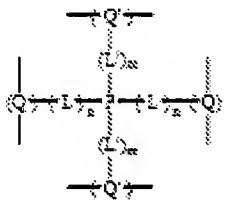
Additionally, Segawa teaches a thiophene based second monomer unit, as Segawa teaches a block poly-BT1/poly-BT structure (see fig. 3).

Regarding Claims 11 and 12, Segawa teaches that a thiophene structure can comprise the additional comonomer unit (see fig. 3).

Regarding Claims 14 and 15, Segawa teaches coordinating the porphyrin with zinc, a metal (see fig. 1 description).

Regarding Claim 16, Segawa teaches preparing the structure with electropolymerization (see introduction).

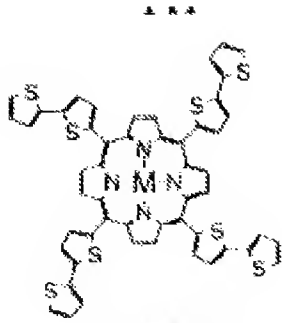
Regarding Claim 22, Segawa teaches a structure of:



(see fig. 4)

The present specification and claims teach that P is a porphyrin or a substituted porphyrin (see claim 5 and pages 8-10), that the linker provides electrical communication (see paragraph 38), and that the polymerizable unit is a substituted thiophene (see claim 2).

Segawa additionally teaches other monomer units such as:



TBTP

Where P is a porphyrin and Q and Q' are thiophene based moieties.

In this case, n = 0, satisfying the limitation of Claim 22. Furthermore, these units can be considered a copolymer, as Segawa et al. teaches them as a copolymer between the porphyrin and the oligothiophene (see introduction), thus further satisfying the limitations of Claim 22.

Regarding Claim 23, Segawa teaches Q and Q' as oligothiophenes (see fig. 1).

Regarding Claim 24, Segawa teaches a copolymer where n, in the linker, is equal to 0 (see section 3.1).

Regarding Claim 25, Segawa et al teaches that P is a porphyrin (see fig. 1).

Regarding Claim 26, Segawa et al. teaches that the polymer can be a copolymer, as the poryphrin can be considered the second monomer unit (see introduction). Additionally, Segawa teaches a thiophene based second monomer unit, as Segawa teaches a block poly-BT1/poly-BT structure (see fig. 3).

Regarding Claims 27-29, Segawa teaches that a thiophene structure can comprise the additional comonomer unit, including a terthiophene (see fig. 3).

Regarding Claim 30, it is the examiner's position that the ratio of Q/Q' to P is 1:2 because each porphyrin is connected to four additional groups (see fig. 4), thus having a molecular ratio of 1:2.

Regarding Claims 31 and 32, Segawa teaches coordinating the porphyrin with zinc, a metal (see fig. 1 description).

Regarding Claim 33, Segawa teaches preparing the structure with electropolymerization (see introduction).

Regarding Claims 36 and 37, Segawa teaches an electrofucntional material comprising a base material and the polymer or copolymer according to Claim 6. In the present specification, application teaches that the base material is ITO coated glass (see example 8). Segawa teaches coating ITO glass with the copolymers as discussed with respect to Claim 6 above (see fig. 6), thus anticipating the present Claims 36 and 37.

Regarding Claims 38-40, Segawa teaches treating a base material of BT and BTI, which satisfy the limitations of Claim 1 as BTI includes an oxygen linker (see fig. 1, fig. 3, and column 1, page 2153), and polymerizing the units (see page 2153, column 1, first full paragraph). Furthermore, the bithiophene (BT) can be considered the additional monomer unit in Claim 39, and BT is a oligothiophene (see page 2153, column 1, first full paragraph).

Regarding Claims 41 and 42, Segawa teaches that the base material used is a glass (see fig. 6).

Regarding Claim 43, Segawa teaches forming the polymers with electrochemical oxidation (see abstract).

Regarding Claims 44 and 45, Segawa teaches a method of harvesting light comprising applying a polymer or copolymer according to claim 6, of a molecule according to claim 1 to a surface (see fig. 3). Additionally, Segawa teaches that these polymers/co-polymers can be formed on the surface (see section 3.4). Furthermore, Segawa et al. teaches photoirradiating the surface (see fig. 3) and capturing the current (see fig. 3).

Regarding Claim 46, Segawa teaches substituted thiophene as additional monomer units (see fig. 6).

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 13, 17-21, 29 and 47 are rejected under 35 U.S.C. 103(a) as being unpatentable over in view of and further in view of On Too, "Photovoltaic devices based on polythiophenes and substituted polythiophenes", Synthetic Materials, 2001.

Regarding Claims 13 and 29, Segawa teaches an electrofunctional polymer as discussed above.

Segawa does not teach incorporating terthiophene into a copolymer unit.

On Too teaches incorporating a terthiophene monomer into a similar porphyrin photovoltaic structure (see page 54, second full paragraph).

Therefore, it would be obvious to one of ordinary skill in the art to modify the second copolymer unit taught by Segawa by including a terthiophene unit as taught by On Too because terthiophene can enhance the light harvesting capabilities of the polymer (see page 54, second full paragraph).

Regarding Claims 17-21, Segawa does not teach incorporating the double bond linker.

On Too teaches a porphyrin/terthiophene structure with a double bond linker (see II) and that this enhances light harvesting capabilities (see section 2.1).

Therefore, it would be obvious to one of ordinary skill in the art to modify the polymers taught by Segawa by including the double bond linking group because this can shift absorption and enhance light harvesting capabilities (see section 2.1).

Regarding Claim 47, On Too teaches using the device in a photovoltaic cell (see section 2.2) with identical components to the test cell taught by Segawa (see fig. 3).

10. Claims 34 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hevesi et al. as applied above, in view of Ono, U.S. Patent No. 6,740,807, or, alternatively rejected as unpatentable over Segawa et al. in view of Ono.

Regarding Claims 34 and 35, Hevesi teaches a molecule as discussed above. Neither Hevesi nor Segawa teaches a SO_3 solubilizing group.

Ono teaches a porphyrin compound featuring an acidic group including SO3, and that the choice of acidic groups helps determine the absorption spectra to which a semiconductor is sensitized (see column 10, lines 50-65). Although Ono uses its porphyrin compound as part of a dye in a dye sensitized cell, Ono is analogous because Segawa teaches that energetical tunability is an exemplary advantage of the polymers taught (see section 3.5).

Therefore, it would be obvious to one of ordinary skill in the art to modify the solubilizing groups taught by Hevesi by including the SO3 group as taught by Ono because the choice of acidic groups helps determine the absorption spectra to which a semiconductor is sensitized (see column 10, lines 35-50).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MATTHEW T. MARTIN whose telephone number is (571)270-7871. The examiner can normally be reached on 8:30 to 5:00 EST Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Sines can be reached on (571)272-1263. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MATTHEW T MARTIN/
Examiner, Art Unit 1795

/Jennifer K. Michener/

Supervisory Patent Examiner, Art Unit 1795